

# Mesh Network Architecture for Enabling Inter- Spacecraft Communication

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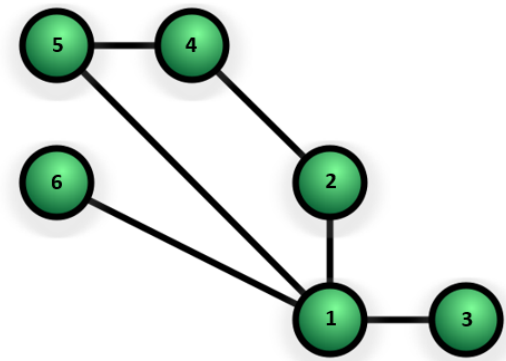
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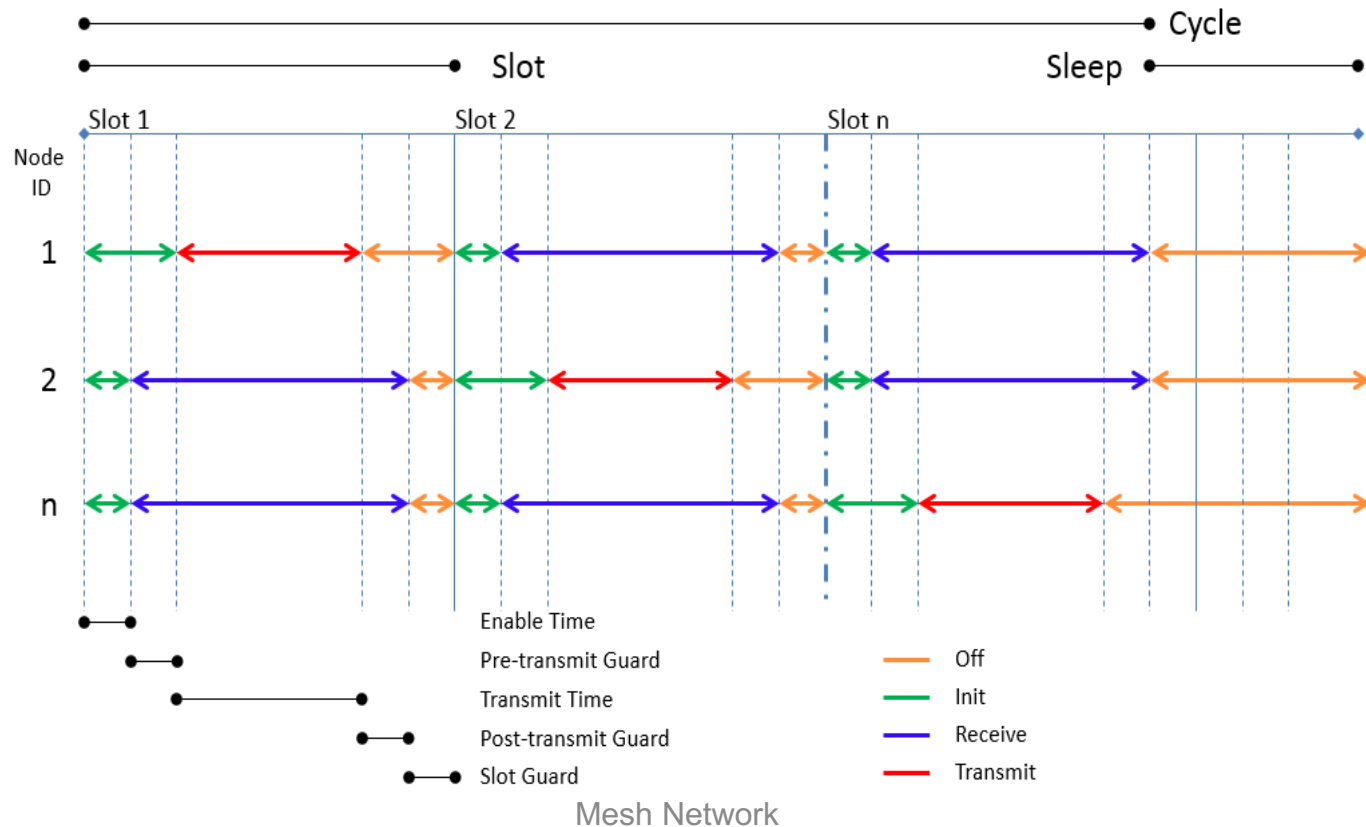
# Overview and Design Goals

- Primary Goal: Implement a mesh network communication architecture to enable spacecraft collaboration and reduce ground communication requirements.
- Driving design requirements:
  - Peer-to-peer network design without a master control node.
  - Adaptability and re-configurability.
  - Data relay.
  - Hardware independence.



# Network Architecture

- Network is based on a Time Division Multiple Access (TDMA) scheme.
- Each network node has an assigned broadcast slot during which it can send data and the other network assets will receive.
- Network parameters are configurable to allow for adapting the network for different applications.

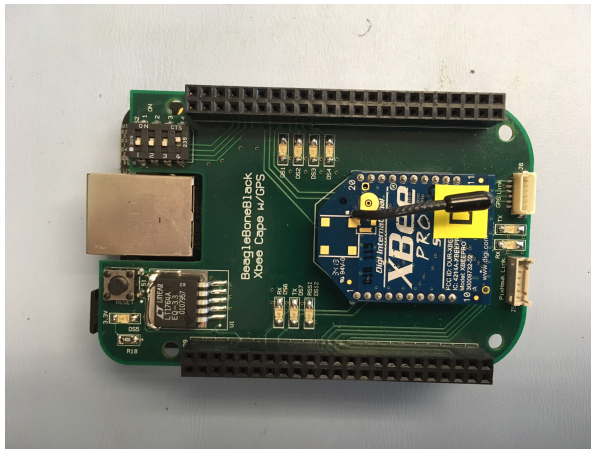




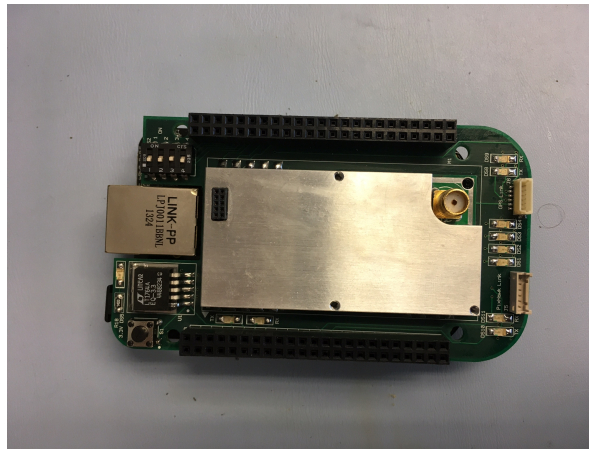
# Software/Hardware

- Initial software development was performed in Python.
- Network logic was ported to VHDL for the current generation which uses an FPGA to further refine networking timing.
- C++ implementation also available.
- The BeagleBone Black single-board computer was chosen as a flight computer analog for rapid hardware evolution and testing.

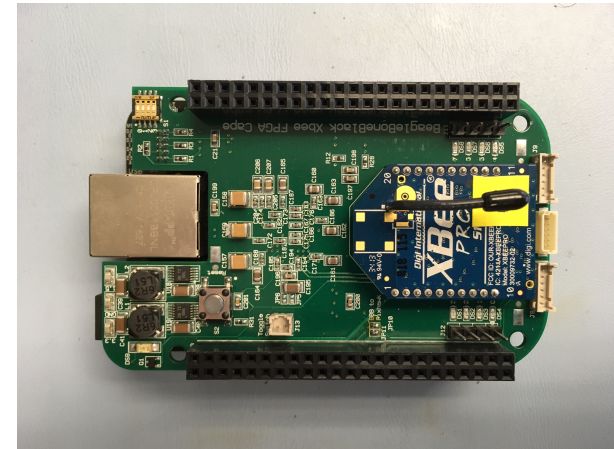
2<sup>nd</sup> generation XBee node



2<sup>nd</sup> generation AstroDev node

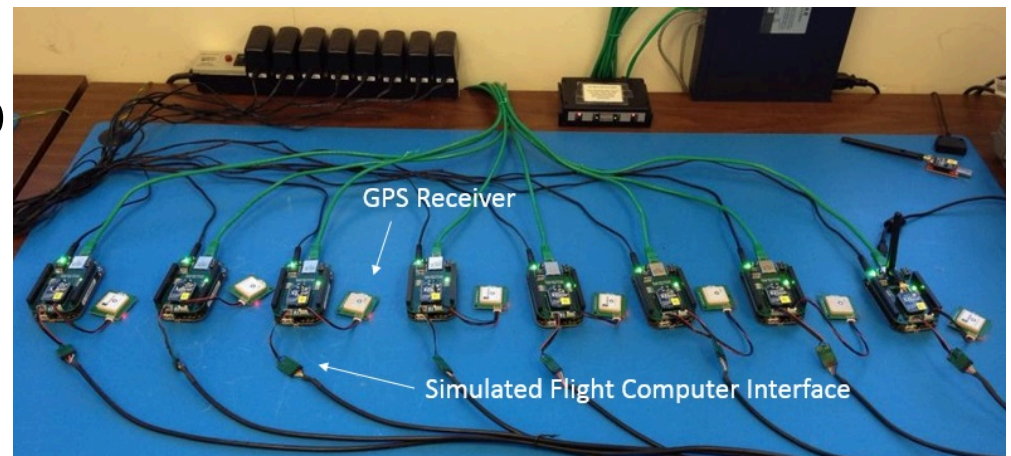


3<sup>rd</sup> generation FPGA node





- To stress test and prove out the network control, small unmanned aerial vehicles were used as a flight test platform.
- A spacecraft deployment scenario was tested via simulation.



<https://www.youtube.com/watch?v=oH9C43To3Dk>

- A peer-to-peer, master-free mesh network was developed and demonstrated to enable collaboration between spacecraft and reduce reliance on ground communication.
- Future development goals:
  - Implement dynamic, autonomous network reconfiguration to reduce dependence on prior knowledge of the number of network assets.
  - Move to a flight-ready hardware and software implementation to prepare for future flight opportunities.

Software available open-source from the NASA Software Catalog:

<https://software.nasa.gov>

Or from the NASA Github site:

<https://www.github.com/nasa/meshNetwork>